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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Horace P. Halling — Group Art Unit: 3676

Serial No: 10/629,501 — Examiner: Vishal Patel

Filed: July 29, 2003 — Fax Number: 703-872-9306

Title of Invention: Metallic Seal — Attorney Docket No. 03-150

DECLARATION UNDER RULE 132 OF HORACE P. HALLING

I, Horace P. Halling, do hereby declare that:

1) I am the sole inventor of the invention described and claimed in the above-identified patent application.

2) I have a H.N.C. Mechanical Engineering with distinction and an O.N.C. Mechanical & Production Engineering. I have over 46 years of mechanical design experience with a particular emphasis on the design of metal sealing devices, resilient metal seals, sealing rings, multiple-ply sealing rings, and bellows-sealed flexible joints. I worked at many high-tech companies including Jetseal, Inc., Advanced Products Company, Seal Science & Technology, Inc., EG & G Pressure Science, Pressure Science, Inc., British Aerospace, Avica Equipment, Ltd., Honeywell Controls, and Hawker Siddeley Aviation.

3) I am either a sole inventor or co-inventor for at least 28 U.S. patents. A list of these patents is attached hereto as Exhibit A. The subject matter of at least eighteen of

these patents is directed to seals, resilient seals, metallic seals and pressure energized seals.

4) I am a co-inventor of the invention described and claimed in U.S. Patent No. 4,457,523 (the "'523 patent") which the Examiner has cited in the Office Action mailed July 22, 2004. Therefore, I am very familiar with the particular prior art seal described in the '523 patent.

5) Although the seal described in the '523 patent and the claimed seal of the present invention are both generally annular in shape, there are salient, geometric and structural differences between these two seals. These differences affect both the load exerted on the inner cylindrical connecting body and the degree of difficulty of manufacture.

6) Sealing ring 12', shown in FIG. 6 of the '523 patent, and the seal of the present invention are designed to be pressure-energized. This means that each seal is designed so that the difference in pressure across the annular space they divide generates forces that tend to increase the contact stresses that are exerted by the seal against contiguous surfaces of the co-operating bodies. However, there are significant geometrical, structural and functional differences between sealing ring 12' described in the '523 patent and the seal of the present invention. Such differences are now explained in the ensuing paragraphs.

7) As shown in FIG. 6 of the '523 patent, sealing ring 12' comprises a central tapering portion 42' having first and second ends 43' and 44', a first sealing portion 46' extending from the first end 43' and a second sealing portion 47' extending from the second end 44'. Each sealing portion 46' and 47' is curvilinear in cross-section wherein the cross-section is arcuate and substantially semi-circular. As shown in FIG. 6, the overall cross-section of sealing ring 12', including the two sealing portions 46' and 47' and the central portion 42', is substantially C-shaped.

8) On the other hand, the seal of the present invention has a different structure and geometry. In describing these differences, I will be referring to the diagram attached hereto as Exhibit B so that my explanation will be clear and unambiguous. Each portion of the seal is labeled in accordance with the ensuing description. The seal of the present invention has a generally "j" shaped or hook-shaped cross-section. (This is apparent from viewing Figures 2, 4, 5, 6 and 7 of the present application). The seal comprises a first end portion which has a first distal end, a generally curled second end portion that extends to a second distal end, and a central body portion between and contiguous with the first and second end portions. The central body portion has a generally frustro-conical shape. The seal has a first side and an opposite second side. The

second end portion curls in a first direction in accordance with a predetermined radius such that the second distal end is located across from the first side of the seal member and the first and second distal ends do not face each other. The portion of the first end portion having the first distal end, indicated by the letter "A", is slightly angulated in the first direction. However, the first and second distal ends do not face each other. The slight angulation of portion "A" facilitates assembly of a sliding member, such as a probe, into the seal. The slight angulation of portion "A" provides for a relatively smaller second moment of area. Thus, the force required to dilate the opening of the seal is considerably reduced in comparison to an end portion having a significantly large curl as does end portion 43' of sealing ring 12' shown in FIG. 6 of the '523 patent. A resulting advantage of the particular shape of the seal of the present invention, and its end portion "A", is that it minimizes wear in dynamic applications or repeated insertions.

9) There is another structural difference between the seal of the present invention and sealing ring 12' shown in FIG. 6 of the '523 patent. Specifically, sealing ring 12' has multiple inflection points in central tapering portion 42'. These inflection points are represented by a concave portion 54 that extends from second sealing portion 47' and convex portion

55 that extends from the first sealing portion 46'. These inflection points are essential for pressure energization of sealing ring 12'. Contrarily, in the seal of the present invention, the central body portion (indicated by reference numbers 32, 44 or 74 in the drawings of the present application) does not have any such inflection points but instead, is substantially frustro-conical. Furthermore, the seal of the present invention still achieves pressure-energization without such inflection points.

10) A further advantage of the seal of the present invention is that, in comparison to the seal embodiments described in the '523 patent, the seal of the present invention is better suited for mainly axial displacements and can be used at very high temperatures. On the other hand, sealing ring 12 shown in FIGS. 1-5 of the '523 patent is not a pressure-energized seal. The sealing ring 12' shown in FIG. 6 of the '523 patent, and alternate embodiments shown in FIGS. 7 and 8 of the '523 patent, have not, to my knowledge, ever been produced due to perceived difficulties in the manufacturing process and the lack of any suitable applications.

11) The Examiner has also cited Spence Patent Application Publication No. US 2003/0107188 ("Spence"). Spence discloses metallic seal 10 which has first annular end section 31, a second annular end section 32 and a third annular center section

33. The first and second annular end sections 31 and 32 have curved cross-sectional profiles, while the third annular section 33 has a straight cross-sectional profile. The annular sections 31, 32 and 33 are configured to form a somewhat S-shaped cross-section *(emphasis added)*. The S-shaped cross-section is preferably uniform along the entire circumference of the metal seal 10 (see Spence, paragraph 0036). Thus, the particular metallic seal 10 disclosed in Spence has a totally different structure than the annular seal member of the present application.

12) The undersigned being warned that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001, and that such willful false statements and the like may jeopardize the validity of the patent application, this document or any patent resulting therefrom, declares that all statements made of his own knowledge are true; and all statements made on information and belief are believed to be true.

Dated: November 1, 2004 Horace P. Halling